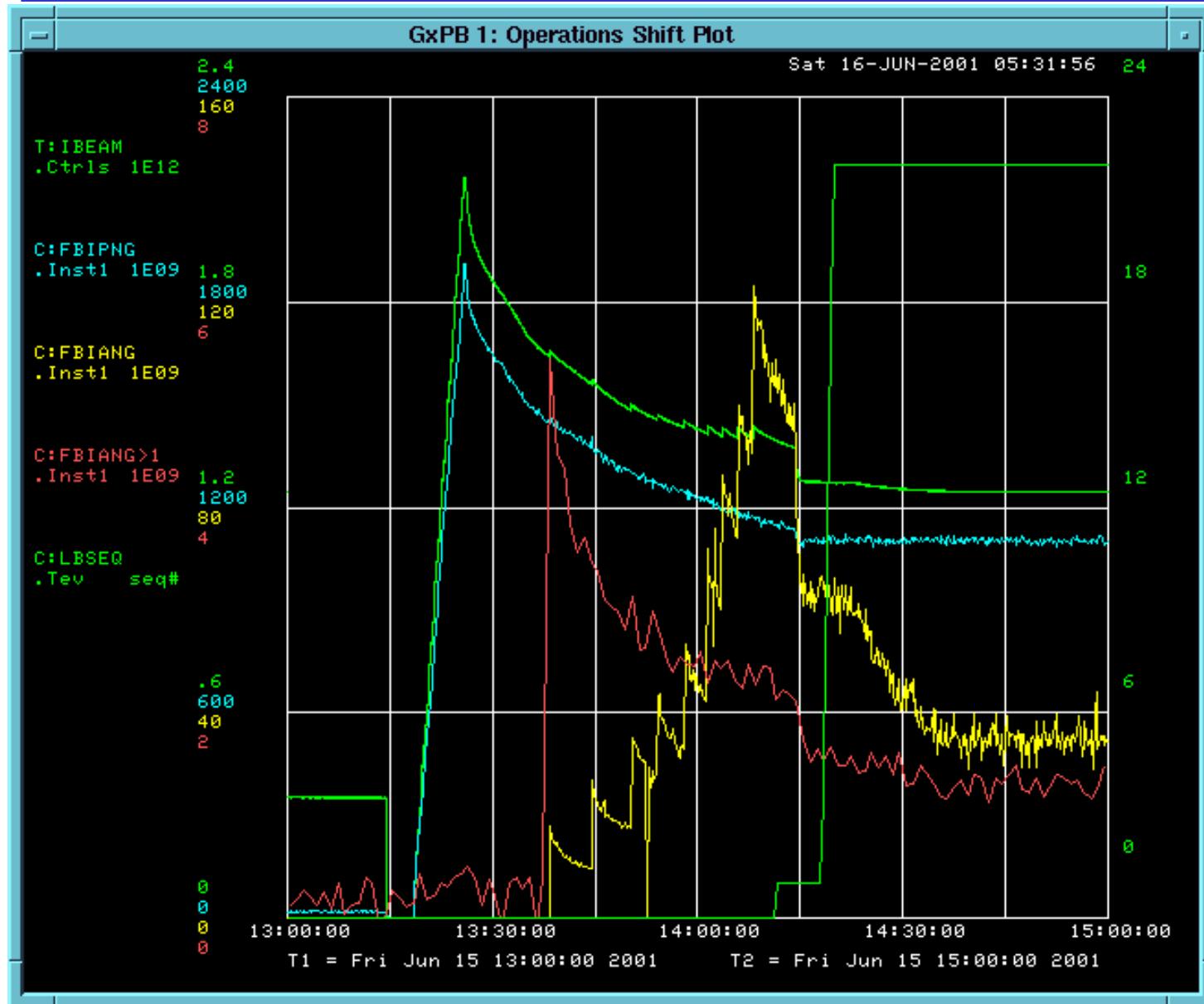




Beam-Beam Effects and Tevatron Inefficiencies: Past, Present and Future

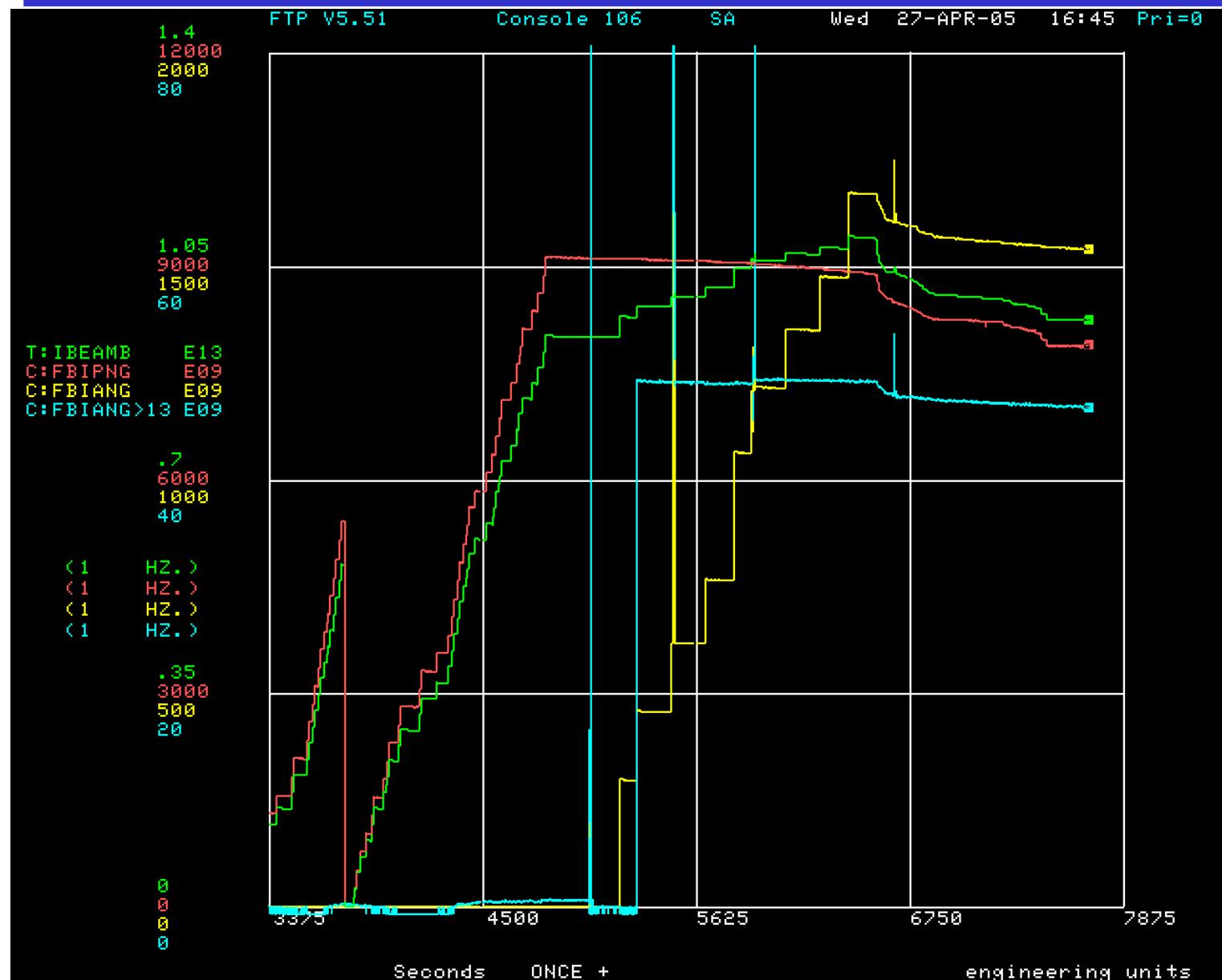
from "Beam-Beam Paper"
V.Shiltsev et al

Tevatron Inefficiencies: 2001

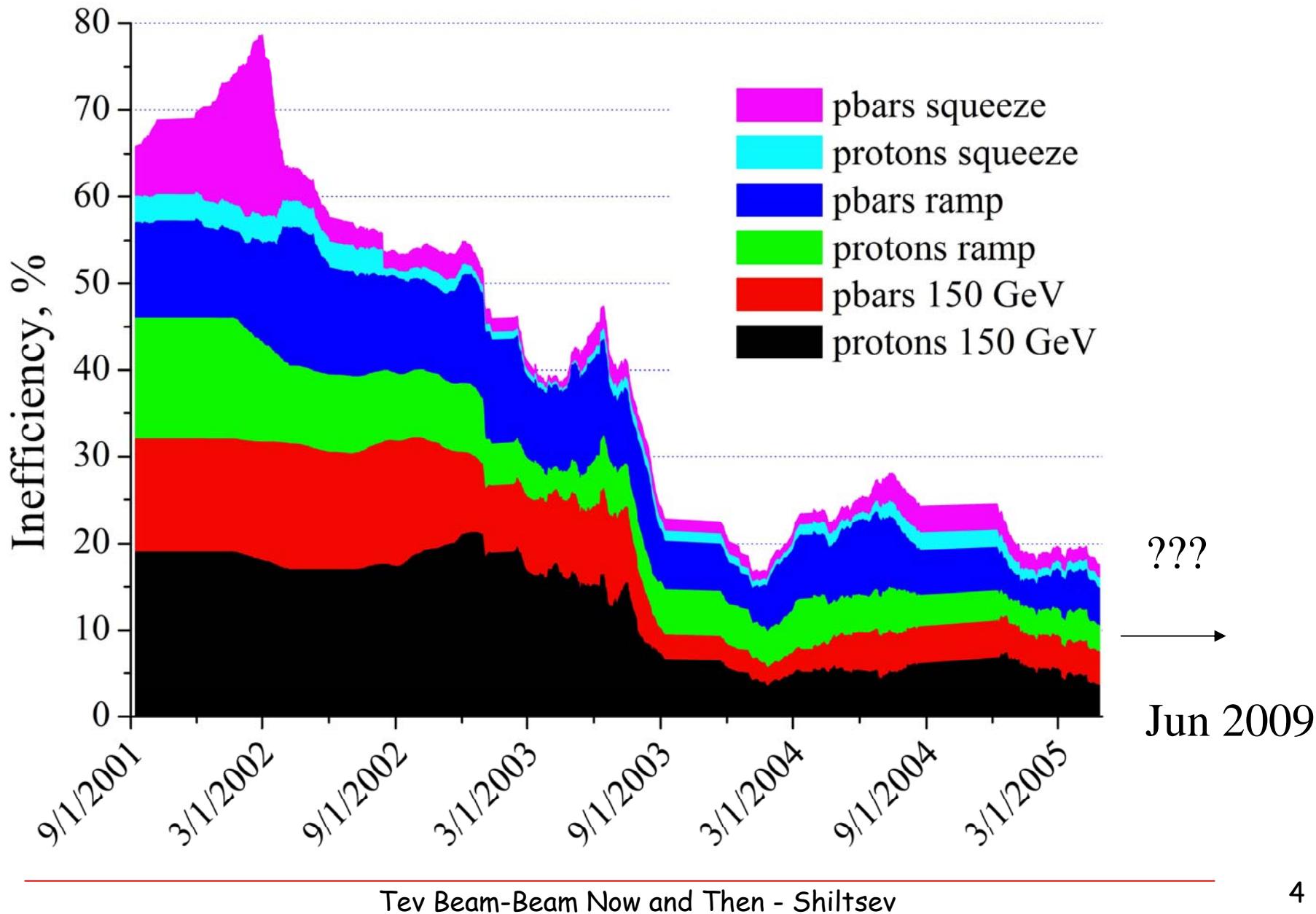


Store #535
Jun 15, 2001

Tevatron Inefficiencies: 2005

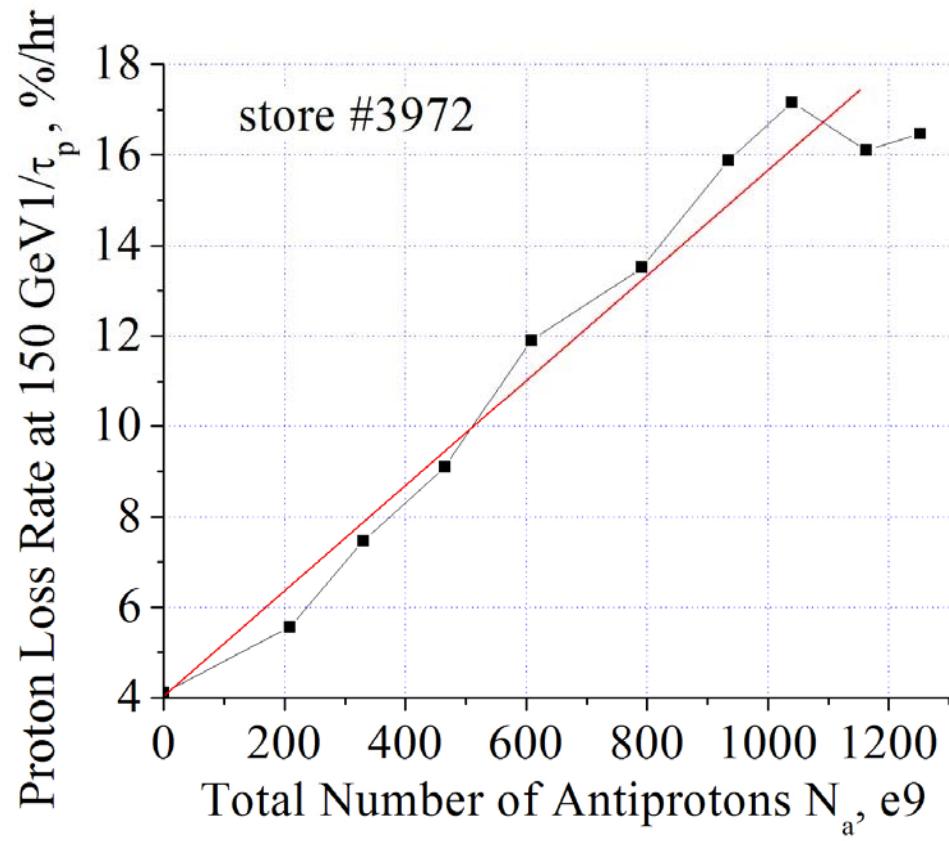
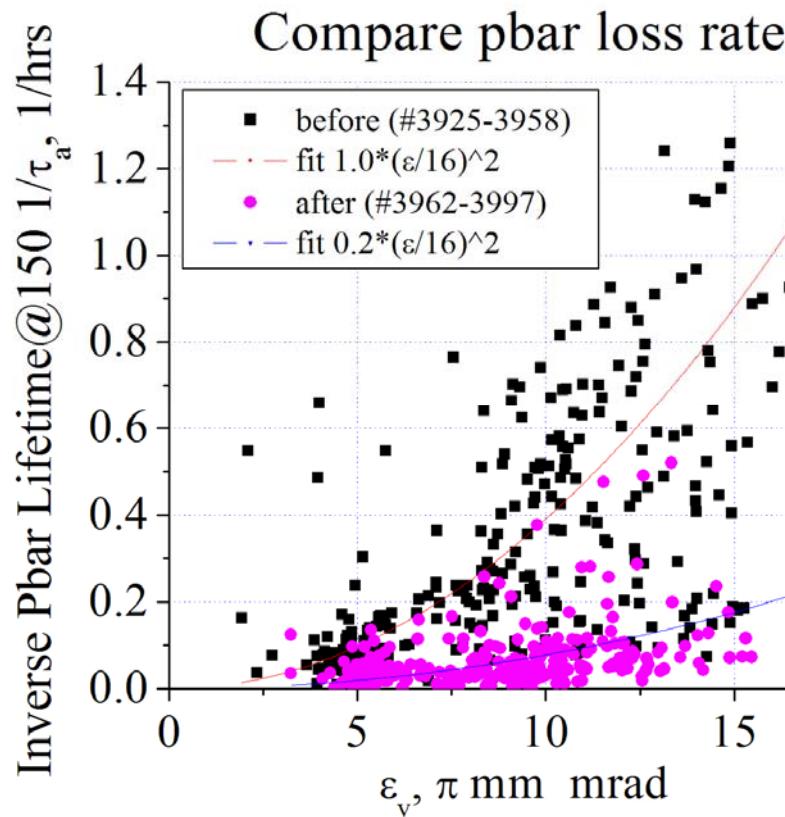


Tevatron Inefficiencies: 2001-2005



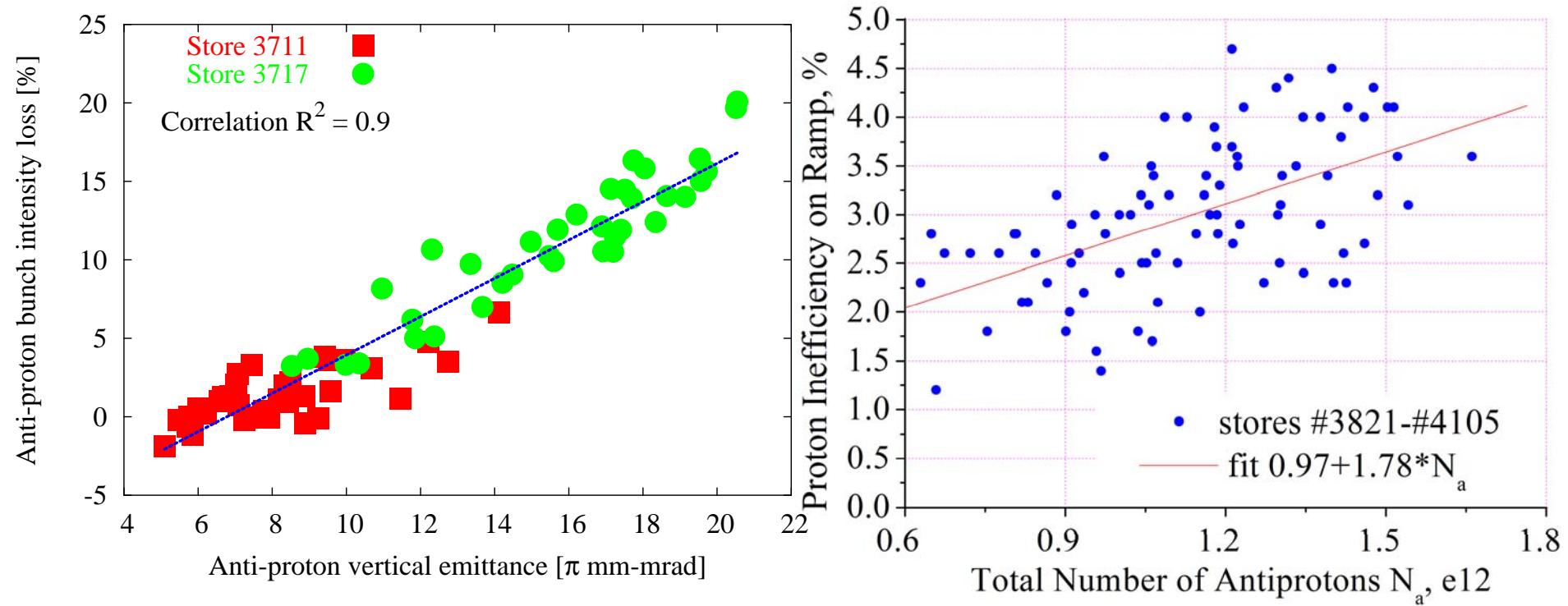
Beam Loss at Injection Helix

$$\frac{dN_{a,p}}{N_{a,p}} \propto \sqrt{t} \cdot \varepsilon_{a,p}^2 N_{p,a} Q'_{a,p} \times F_1(S_{a-p}, Q_{a,p}, \frac{dP}{P})$$



Beam Loss on Ramp

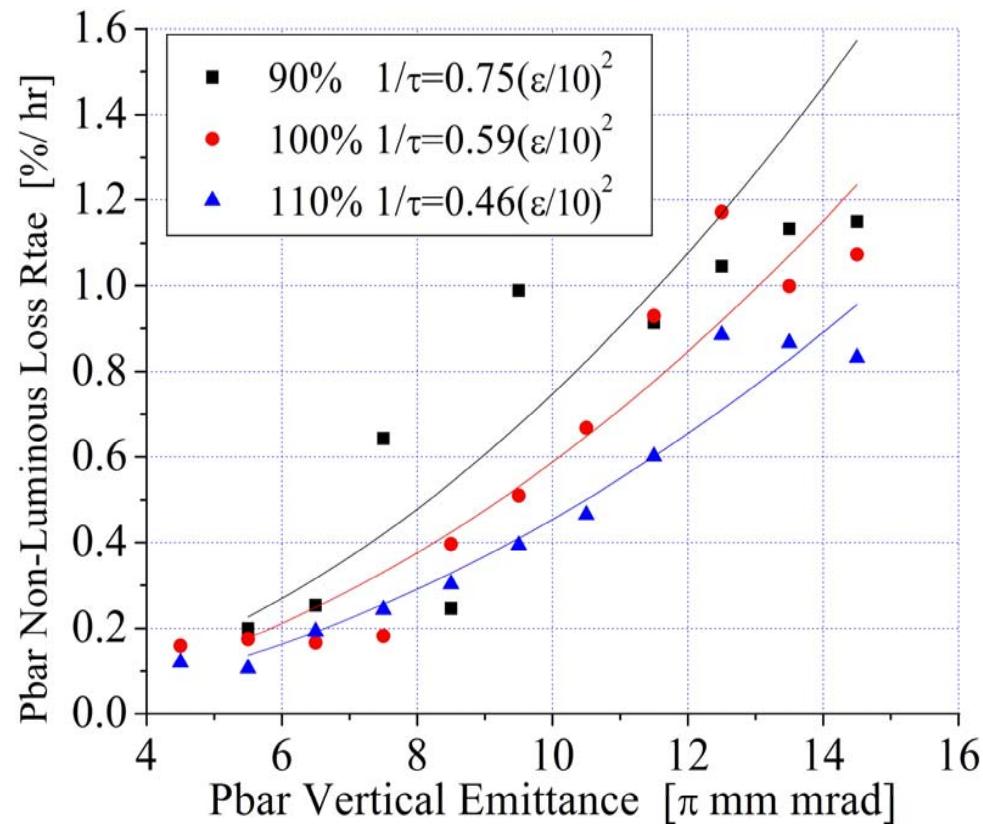
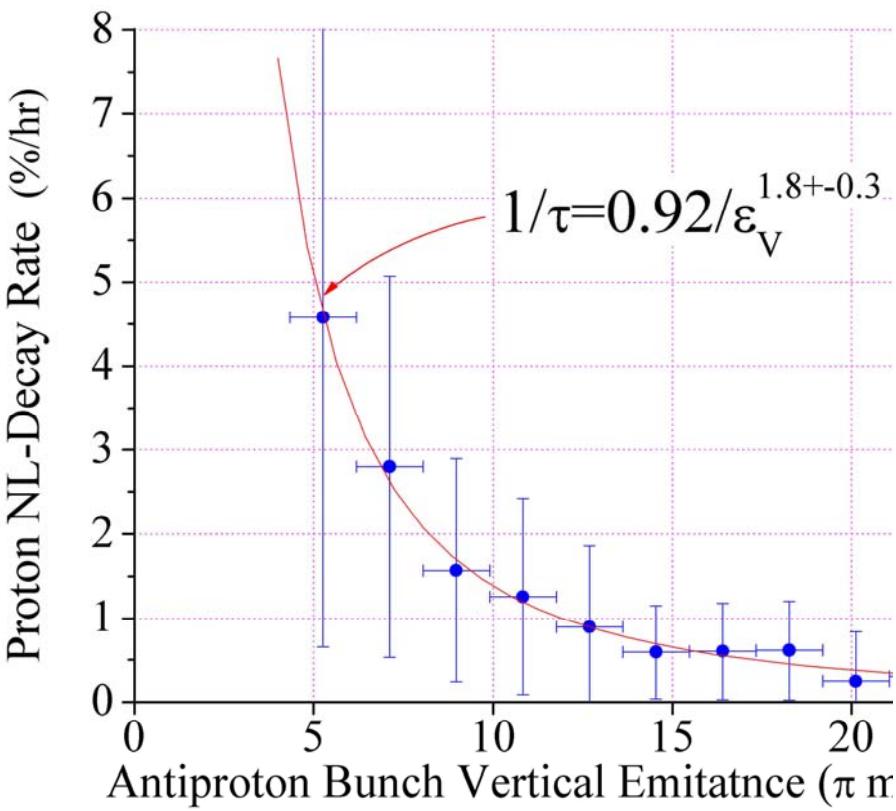
$$\frac{dN_{a,p}}{N_{a,p}} \propto \varepsilon_{a,p}^2 N_{p,a} \times F_2(S_{a-p}, Q_{a,p}, Q'_{a,p})$$



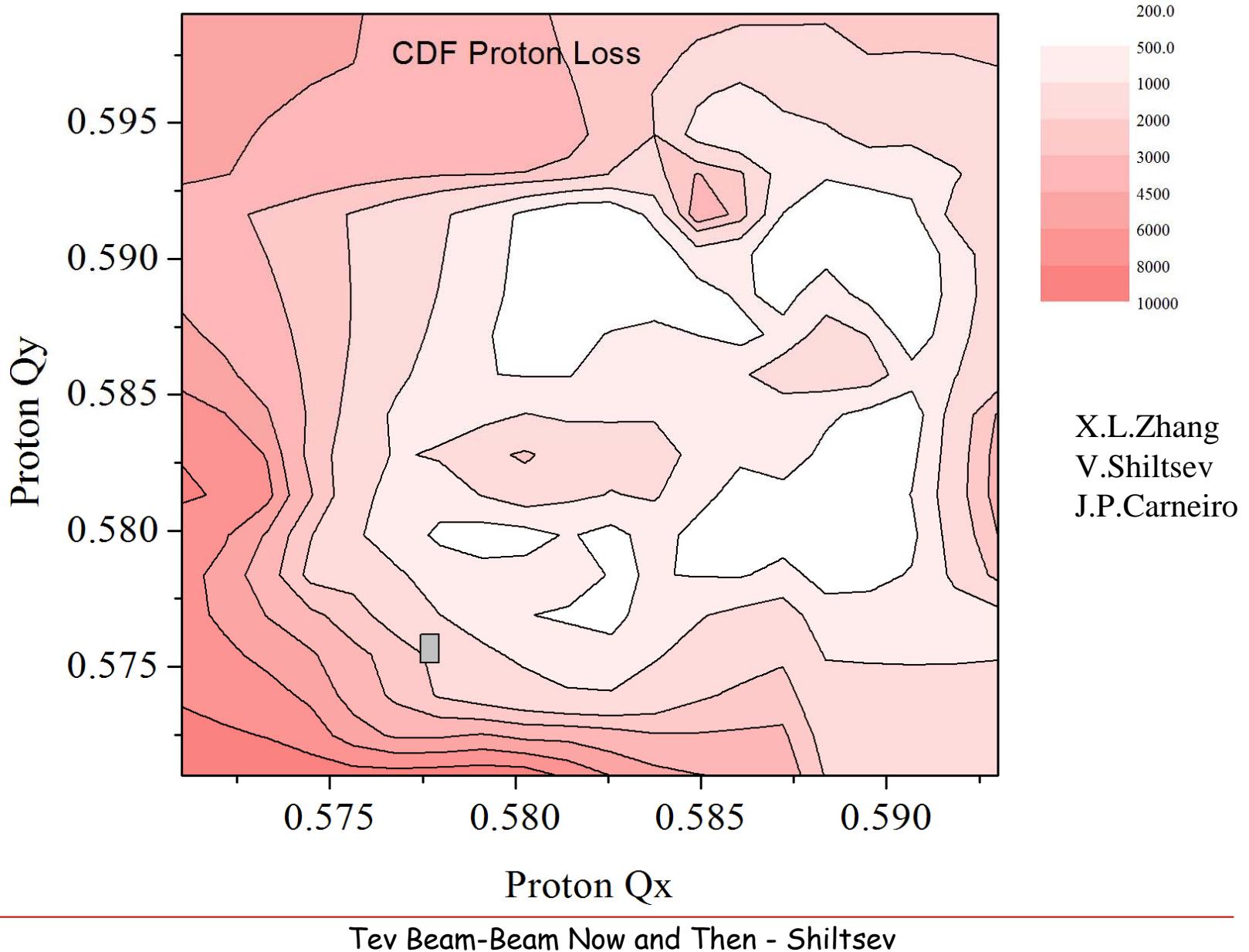
Beam Loss in Collisions

$$\frac{dN_p}{N_p dt} \propto \frac{N_a}{\varepsilon_a^2} \times F_3(Q_p, Q'_p)$$

$$\frac{dN_a}{N_a dt} \propto N_p \frac{\varepsilon_a^2}{S_{a-p}^3} \times F_4(Q_a, Q'_a)$$



For Example: Function $F_3(Q_{x,y})$



Projections for FY09

- Now (mar-Apr 2005)
- FY09 if 3xN_a
- FY09 if 3xN_a and 1.4xEmittance_a

IF RUN "AS NOW"!

P at 150	$4.4\% \pm 2.8$	13.2	13.2
A at 150	$3.9\% \pm 2.2$	3.9	7.8
P ramp	$3.4\% \pm 0.9$	8.2	8.2
A ramp	$4.7\% \pm 1.2$	4.7	8.4
P squeeze	$1.0\% \pm 0.4$	3.0	3.0
A squeeze	$1.5\% \pm 0.5$	1.5	2.0
<i>Total before LB</i>	$18.9\% \pm 3.9$	34.5	42.6
Tau_p at LB	$160 \text{ hr} \pm 60$	~60	~100
<u>Tau_a at LB</u>	<u>$160 \text{ hr} \pm 60$</u>	<u>~160</u>	<u>~80</u>
<i>Total in Tau_L</i>	$10\% \pm 5$	~13%	~13%
<i>Total Int-L</i>	$28\% \pm 7$	44%	50%

What Can Be Done:

- Better WP for protons at 150, ramp and at LB: $7/12 < Q < 3/5$
- Stabilize pbar tunes in collisions
- Increase helix on ramp and at LB (higher voltage seps, more)
- Drop Q' on ramp and in collisions (octupoles, FB?)
- Reduce beam emittances (inj dampers, MI, RR, AA, Booster)
- Beam-Beam Compensation with TELs